ALQ-172 RANDOM AGILE DEINTERLEAVER INSERTION

WR-ALC/LNERB

Electronic Warfare Management Directorate
Warner Robins Air Logistics Center
Robins Air Force Base, Georgia

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Approved for Public Distribution

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INTRODUCTION

The Random Agile Deinterleaver (RAD) is a software approach to radio pulse sorting using advanced algorithms developed by Wright Laboratory's Electronic Warfare Division. RAD incorporates advanced signal processing and pattern recognition capabilities, specifically allowing more threat generic and less threat specific processing.

This project inserted the newly developed RAD software algorithm into the AN/ALQ-172 electronic countermeasures (ECM) jammer allowing for significant reduction in code development and maintenance.

The project was originated by WR-ALC/LNERB.

EXECUTIVE SUMMARY

To maintain Air Force ECM systems, WR-ALC must upgrade software to counter new and emerging threats as well as to maintain system robustness. A rapid reprogramming capability is crucial to allow users to react swiftly to changing threat environments and to conduct effective electronic warfare missions. Upgrades and maintenance involve changes to hardware, the Operational Flight Program (OFP), or emitter identification (EID) mission data. Those that require hardware changes or code changes in the OFP are the most expensive, complex, time consuming, and risky. Certain upgrades only change EID mission data to address emerging threats on an individual basis. These are the cheapest, fastest, and easiest changes to accomplish; the using command controls them without generating a formal Operational Change Request (OCR), implementing them on the flightline by downloading data to an electrically erasable, programmable, read-only memory (EEPROM) using a standard Memory Loader Verifier. Developing software technologies that avoid OFP changes requires far less engineering redevelopment (a major cost driver) while providing easier, more flexible maintenance at the depot and in the field. These technologies would increase combat capability, decrease the support structure, and save operation and support costs.

The Random Agile Deinterleaver (RAD) is a software approach to radio pulse sorting using advanced algorithms developed by Wright Laboratory's Electronic Warfare Division. RAD incorporates advanced signal processing and pattern recognition capabilities, specifically allowing more threat generic and less threat specific processing. It simplifies the software maintenance process while greatly improving the process of sorting, identifying, and tracking hostile radar emitters. This project inserted the newly developed RAD software algorithm into the AN/ALQ-172 ECM jammer to allow for significant reduction in code development and maintenance. It included five primary objectives: developing RAD's sorter/deinterleaver/tracker functions in an ECM jammer, simplifying software maintenance and support procedures for ALCs and using commands, reducing the AN/ALQ-172 software operation and support costs, developing a mature OFP and EID code that can be directly inserted into the AN/ALQ-172, and validating RAD's ability to accomplish more OFP/EID functions while using less available memory than current algorithms. The primary benefits of the program include expanded flexibility to accommodate emerging threats, significantly reduced software code development, reduced hardware redesign and changes, reduced contractor support, and reduced costs.

Follow-on implementation will be accomplished with the ongoing ECP-93 effort scheduled for implementation in FY98.

TECHNICAL INVESTIGATION

Investigations and Findings

This effort was divided into a two-phased risk reduction effort. Phase I consisted of a feasibility study, which resulted in a recommendation by ITT that the algorithm be inserted into the ALQ-172. Modifications to the algorithm were made to allow the time constraints required by an ECM system to be met. Phase II of the effort entailed implementing the algorithm and providing a demo to the user community.

Technical Approach

The approach used for implementation included inserting the RAD algorithm into the agile/agile processor. This processor has the function of being the main routine for signal extraction. The secondary RAD parameter was added as an additional identification parameter. The pulse radar supervisory control processor and the sorter processors use this parameter to eliminate ambiguities between signals and to improve tracking.

Results

This effort was very successful. The end product resulted in an increased number of threats countered, increased robustness, and flexibility to accommodate emerging threats without requiring massive changes to the OFP. This effort also proved the usefulness of the RAD algorithm in ECM systems.

LESSONS LEARNED

The primary lesson learned as a result of this effort is that the RAD algorithm can be used effectively by an ECM system. Modifications to the algorithm were needed in order to make it feasible. The trade-off of eliminating unlikely solutions to the algorithm, as opposed to maintaining all possible solutions as in earlier versions, proved to be very effective in reducing execution time and not too costly in accuracy.

The two-phased risk reduction approach proved very effective.

IMPLEMENTATION

The software resulting from this effort will be incorporated into the ALQ-172 system as part of the ECP-93 effort. This effort is to be fielded beginning in FY98.

The follow-on efforts to be completed with ECP-93 included merging of software and completion of hardware changes. These tasks are being performed using funding other than that used for the RAD effort itself.

ECONOMIC SUMMARY

The RAMTIP funds provided were used to contract with ITT on a time and materials basis to complete the two-phased effort. No organic funds were expended for this effort.

RAD Insertion Project Cost: $1,586,487

1. Phase 1: $600,000

2. Phase 2: $986,487

Return of Investment (ROI):

QRAD Insertion Implementation Cost: $200,000

QRAD implementation cost is greatly reduced due to merging this effort with the current ECP-93 modification on the ALQ-172 system. The gross savings will be based on the estimated cost of developing, implementing, and maintaining QRAD effort without merging with ECP-93 modification.

Gross savings total: $32.5M

a. Initial cost of hardware development and maintenance: $30M

b. Annual maintenance over 25 years life cycle of the system: $2.5M

Return on investment (ROI): 17

$$\text{ROI} = \frac{\text{Gross Savings} - (\text{Project Cost} + \text{Implementation Cost})}{(\text{Project Cost} + \text{Implementation Cost})}$$

$$\text{ROI} = \frac{\$32{,}500{,}000 - (\$1{,}586{,}487 + \$200{,}000)}{(\$1{,}586{,}487 + \$200{,}000)}$$

APPENDICES

Coordination and Approval

Distribution

APPROVAL AND COORDINATION

OFFICE SYMBOL	SIGNATURE	DATE
LNERB	[illegible]	17 May 95
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